Media and the First Response
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Radiation Fact Sheet[1]

TABLE 1. Natural Radioactivity: Hazard Pathways, Detection, and Shielding

Radiation type	Physical description	Principal hazard pathways	Ease of detection in the field	Approximate detection distances in air	Typical external shielding requirements
Alpha particle	Helium nucleus (2 protons & 2 neutrons)	Ingestion and inhalation	May be difficult to detect with instruments carried by first responders	Centimeters (inches)	Minimal: does not penetrate skin
Beta particle	Electron	Ingestion and inhalation; external exposure	Easily detected with instruments carried by first responders	Meters (feet)	Plastic or aluminum
Gamma ray	Photon	External exposure	Easily detected with instruments carried by first responders	Tens of meters (tens of feet)	Concrete, lead

TABLE 2. Radioactive Source Isotopes of Potential Concern for Radiological Dispersal Devices (RDDs)

Isotope	Radiation of principal concern	Isotope half-life	Principal uses in radioactive sources	Typical radioactivity levels (curies)
Cobalt-60 (Co-60)	Gamma	5.27 years	Cancer therapy Industrial radiography Industrial gages Sterilization Food irradiation	< 1 to > 10 million
Strontium-90 (Sr-90)	Beta	28.8 years	Radioisotope thermoelectric generators (RTGs)	Up to 300,000
Cesium-137 (Cs-137)	Gamma	30.1 years	Cancer therapy Industrial radiography Industrial gages Sterilization Food irradiation Well logging	< 1 to > 10 million
Plutonium-238 (Pu-238)	Alpha	87.7 years	Neutron source [Pu/Be] used for research; previously used for well logging	< 50
Americium-241 (Am-241)	Alpha	432 years	Industrial gages Well logging [Am/Be neutron source]	<20

SOURCES: Ferguson and others, 2003; Lederer and Shirley, 1978; Lee Leonard, LANL, written communication.

[1] Prepared by Dr. Kevin Crowley, Director, Board on Radioactive Waste Management, National Research Council.

Commonly Used Terms

Activity—The rate at which a material emits radiation, usually expressed in terms of curies or becquerels. One curie equals 37 billion radioactive decays per second; one becquerel equals one decay per second.

Alpha particle—A particle containing two protons and two neutrons that is emitted during the radioactive decay of some isotopes.

Background radiation—The natural radiation field that exists at any location on Earth. Sources of background radiation include cosmic and solar rays, radioactive isotopes in the Earth's crust, and building materials (e.g., bricks, stone) containing such isotopes.

Beta particle—A particle containing an electron that is emitted during the radioactive decay of some isotopes.

Curie (Ci)—A unit of measure for radioactive decay that is equal to 37 billion radioactive decays per second.

Gamma ray—A photon emitted during the radioactive decay of some isotopes.

Half-life—The average time required for one half of the atoms in a radioactive material to undergo decay.

Ionizing radiation—Radiation that is sufficiently energetic to strip electrons from the atoms through which they pass. Such atoms and the removed electrons are said to be "ionized" because they have positive or negative charges. Alpha particles, beta particles, and gamma rays are examples of ionizing radiation.

Isotopes—Two or more atoms of the same element that differ only by the number of neutrons contained in their nucleus: For example, plutonium-238, which contains 144 neutrons, and plutonium-239, which contains 145 neutrons, are both isotopes of the element plutonium.

Radiation—Same as ionizing radiation.

Radiation detector—An instrument that is capable of detecting the emissions (alpha or beta particles, gamma rays) arising from the decay of radioactive materials.

Radioactive decay—The spontaneous emission of particles (alpha or beta particles) or photons (gamma rays) from a radioactive material.

Radioactive source—A device that contains a known amount of a radioactive isotope. Such sources are used widely in medicine, industry, and research.

Radioactivity—Same as activity.

Radioisotope thermoelectric generator—A device that utilizes a radioactive source to generate heat, which in turn is used to generate electricity. RTGs are used where compact and long-lived sources of electrical power are needed for remote applications, such as space exploration and navigational systems.

Radiological dispersal device (RDD)—A terrorist device that is designed to create panic by contaminating an area with radioactive material. Such devices might consist of a radioactive source packed with an explosive charge that, when detonated, spreads radioactive contamination, possibly denying the area to human occupation until some remedial action (e.g., cleanup) is taken.

References

Bodansky, D. 1996. Nuclear Energy: Principles, Practices, and Prospects. New York: American Institute of Physics Press.

Ferguson, C.D., T. Kazi, and J. Perera. 2003. Commercial radioactive sources: Surveying the security risks. Occasional Paper No. 11: Monterey, California. Monterey Institute of International Studies. <http://cns.miis.edu/pubs/opapers/op11/>

Lederer, C.M., and V.S. Shirley, editors. 1978. Table of Isotopes, 7th edition. New York: John Wiley and Sons, Inc.